



# National Transportation Safety Board Aviation Accident Final Report

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<b>Location:</b>	BANGOR, ME	<b>Accident Number:</b>	NYC97FA045
<b>Date &amp; Time:</b>	01/10/1997, 0923 EST	<b>Registration:</b>	N139ZV
<b>Aircraft:</b>	Beech 1900D	<b>Aircraft Damage:</b>	Substantial
<b>Defining Event:</b>		<b>Injuries:</b>	2 Minor, 9 None
<b>Flight Conducted Under:</b>	Part 135: Air Taxi & Commuter - Scheduled		

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## Analysis

During takeoff roll, as the FO rotated the airplane, the stall warning horn activated. The airplane lifted from the runway with the stall horn on, and above V1 speed the PIC called out to abort. The FO aborted the takeoff and landed the airplane on the runway. The airplane then entered a snow bank on the left side of the runway. Service Difficulty Reports revealed other stall horn activation's had occurred on takeoff; several occurred after deicing and were attributed to frozen stall vanes on the wing. The accident airplane had been deiced prior to the takeoff. The BE1900 check list called for the stall vane heat to be turned on just before takeoff. Stall training provided by the operator did not include BE1900 simulators, and all recoveries were initiated at the stall horn. The FAA practical test standard for type ratings required the recognition of the stall buffet, stick shaker, or decay of control effectiveness. The flight crew had not received winter operations training, and this was the Boston based PIC's third takeoff in snow. Multiple FAA inspections over several years revealed the Operator was not in compliance with regulations, which included their training program; however, they continued to operate unrestricted. Airport operations had ceased snow plowing the 300 foot wide runway to accommodate airline operations, and reported the runway had been plowed 75 feet west and 150 feet east of runway center. The runway was measured to be plowed 55 feet left of center, with a 1 foot high, and 10 foot wide pile of snow on the west side of the runway. The plowed portion had an icy covering.

## Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The inadequate flight and winter operations training provided by the operator, and the pilot's improper decision to abort the takeoff while airborne above V1, due to a false stall warning horn. Also casual was the airport operations improper decision to discontinue plowing, and their failure to remove a snow pile on the runway. Factors relating to the accident were an easterly crosswind, the narrow icy runway conditions, inadequate FAA oversight in allowing the operator to continue operations with an inadequate training program that continued over several years, and the manufacturer's checklist which delayed the activation of the stall vane heat until just prior to takeoff.

## Findings

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Occurrence #1: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION  
Phase of Operation: TAKEOFF - INITIAL CLIMB

### Findings

1. STALL WARNING SYSTEM - ACTIVATED
2. (C) ABORT ABOVE V1 - IMPROPER - PILOT IN COMMAND
3. (C) INADEQUATE TRAINING - COMPANY/OPERATOR MANAGEMENT
4. (F) INADEQUATE SURVEILLANCE OF OPERATION - FAA(ORGANIZATION)
5. (F) CONDITION(S)/STEP(S) IN IMPROPER SEQUENCE - MANUFACTURER

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Occurrence #2: ON GROUND/WATER ENCOUNTER WITH TERRAIN/WATER  
Phase of Operation: TAKEOFF - ABORTED

### Findings

6. (F) WEATHER CONDITION - CROSSWIND
7. (F) AIRPORT FACILITIES,RUNWAY/LANDING AREA CONDITION - ICY
8. (F) AIRPORT FACILITIES,RUNWAY/LANDING AREA CONDITION - NARROW
9. (C) AIRPORT SNOW REMOVAL - DISCONTINUED - AIRPORT PERSONNEL
10. TERRAIN CONDITION - SNOWBANK

## Factual Information

### HISTORY OF FLIGHT

On January 10, 1997, at 0923 eastern standard time, a Beech 1900D, N139ZV, operated by Mesa Airlines, Inc., doing business as USAir Express Flight 5326, was substantially damaged during an aborted climb after takeoff at the Bangor International Airport, Bangor, Maine. The certificated airline transport captain, first officer, and seven passengers were not injured. Two passengers received minor injuries. Instrument meteorological conditions prevailed for the scheduled passenger flight, destined for Boston, Massachusetts. An instrument flight rules flight plan had been filed for the flight conducted under 14 CFR Part 135.

The airplane had been flown by the flight crew from Boston, to Bangor International (BGR), and arrived, at 0856. The airplane was fueled, passengers were boarded, and the flightcrew started the engines and taxied to the de-icing area. While in the de-icing area, the engines were shut down and airplane de-icing was initiated at 0912, and completed at 0917. The engines were restarted, and the airplane was taxied to runway 33 for takeoff. At 0921, Flight 5326 was cleared for takeoff by the BGR tower controller.

The first officer (FO) stated that she was the flying pilot. The FO briefed the captain that this was to be a zero degree flap takeoff, and repeated the takeoff speeds to be used. After taxing onto the runway, the FO applied power, began the takeoff roll, and requested that the captain set the final takeoff power.

The cockpit voice recorder (CVR) transcript revealed the following: the flight crew called out the "takeoff final items," at 0921:10; which included ice protection items, at 0921:21; the propeller RPM was heard to increase, at 0921:59; and the FO called out "set takeoff power," at 0922:09. The captain then made the following callouts: "eighty knots cross checked," at 0922:12; "the wind is from the right," at 0922:17; and "V one rotate," at 0922:19.

The CVR revealed the sound of a horn, at 0922:21, which was similar to the stall warning horn. At 0922:26, the captain called out, "abort abort." The sound of the horn ceased, at 0922:28, and the captain called out, "abort Doris Doris," at 0922:29. The CVR recorded the sounds of impact and the recording ended, at 0922:31.

The FO stated that at Vr, she pulled the yoke back with both hands, raised the pitch of the airplane into the command bars, and heard the stall warning horn sound as the airplane rotated. She stated that she released "a little back pressure," observed the airspeed indicator at 120 knots, and applied more back pressure. The airplane then left the ground, but it felt sluggish. She estimated that the airplane was about 20 feet above the runway when the captain commanded, "Abort! Abort!" The FO closed the throttles and the airplane contacted the ground approximately on the centerline of the runway. She stated that, "visibility went to zero because of the flying snow." She then brought the "throttles to Ground Fine," and felt the captain's hand on top of hers as she moved the throttles into reverse.

According to one passenger, the airplane lifted from the runway and the engines were "whining as we started to climb."

The passenger also stated:

"...Very shortly we seemed to level off and then it appeared to me that the pilot was aborting the takeoff...I heard a loud snap and suddenly the fuselage was ripped open..."

Another passenger stated:

"...Rolled onto runway, turned right and proceeded with takeoff. (noted: that there was not spool up to full power with brakes applied before takeoff.) Plane took off and gained 10 - 20 feet altitude. Heard the stall alarm and pilot aborted take-off putting back down on runway, landing about 15 [degree] angle to the right of center line. Nose gear gave way. Right engine propellers broke-off and came through cabin..."

After touch down, the airplane veered left into the snow bank on the runway. The airplane pivoted 90 degrees nose right as it traveled through the snow bank while still on the runway, and exited the snow about 819 feet from the point of entry. The crew and passengers exited through the overwing exits and the main cabin door.

During an interview, the Captain stated that he checked the stall warning vane prior to his leaving the accident site, and found ice had frozen the stall warning vane in position. He said he wiggled the vane and broke it free of ice holding it in place.

The accident occurred during the hours of daylight approximately 44 degrees, 48 minutes north latitude, and 68 degrees, 49 minutes west longitude.

#### FLIGHT CREW INFORMATION

##### Captain

The Captain held an Airline Transport Pilot Certificate with a rating for airplane multiengine land, and was type rated in the Beech 1900, with the limitation that a second in command was required. He also held a Commercial Pilot Certificate for airplane single engine land. His most recent Federal Aviation Administration (FAA) First Class Medical Certificate was issued on December 6, 1996.

The Captain was hired by Mesa Airlines on October 10, 1994, and flew as a First Officer (FO) on the Embraer 120. He was upgraded to Captain in the Beech 1900, and took his type rating check ride in July, 1996. Since the check ride, the Captain estimated that he had flown about 350 to 400 hours in the Beech 1900, all of which was pilot-in-command (PIC). He reported that his total flying experience was about 5,800 hours.

During an interview with the Captain, he stated that he had received no crew resource management (CRM) training. He recalled that he did receive "some" winter operations training during his initial hire training in October, 1994. He also stated that he was unfamiliar with operations in snow conditions, and that this was only his third takeoff and landing in snow. The Captain's base of operation with Mesa was Boston.

##### First Officer

The First Officer (FO) held an Airline Transport Pilot Certificate with a rating for airplane multiengine land, and was type rated in the Cessna 650. She also held a Commercial Pilot Certificate with ratings for airplane single engine land and glider. The FO held a Flight Instructor Certificate with ratings for airplane single engine land, glider, and instrument airplane. Her most recent FAA First Class Medical Certificate was issued on August 8, 1996.

The FO was hired by Mesa Airlines in September, 1995. She received her initial training in the Beech 1900, and had accumulated about 1,100 hours of second-in-command experience in make and model. The FO reported that her total flying experience was approximately 4,100 hours.

During an interview with the FO, she stated she had received "a good 1 1/2 hours of CRM," during her recurrent training in August, 1996. The FO did not recall any winter operation or de-icing training, but did state that winter operations were "mentioned" in the Company Flight Manual and General Operations Manual.

She also stated that she had experienced the stall warning horn activation twice before during takeoff. Each of these resulted in continued flight.

The FO's base of operation with Mesa was Boston.

#### AIRCRAFT INFORMATION

The airplane was equipped with two Pratt & Whitney Canada Inc., PT6A-67D, engines. Each engine was equipped with propellers manufactured by the Hartzell Propeller Inc., Piqua, Ohio. Each propeller assembly consisted of 4 composite material propeller blades, and both the left and right hub and blade assemblies had accumulated about 3,564 hours.

A review of the airplane's maintenance records did not reveal any repetitive discrepancies related to the engines, propellers, anti-icing, flight controls or stall warning systems.

#### AERODROME CONDITIONS

The Bangor International Airport (BGR) had a concrete runway, 15-33, which was 11,439 feet long, 300 feet wide, and was grooved. According to the BGR airfield maintenance supervisor on duty at the time of the accident, the BGR snow removal crews had been plowing runway 15-33, from east to west. At 0815, the FAA BGR air traffic control tower (ATCT) advised the plow crews to clear the runway, due to a Boeing 727 that was to depart in 5 minutes. The plow crews were clear of the runway, at 0855. The maintenance supervisor stated that at that time, runway 15-33 had been plowed 150 feet east, and 75 feet west of the centerline. The supervisor reported that the plowed area was covered with a light dusting of snow less than 1/4 inch high, and braking action was "fair." He also reported that the piles of snow, which were the result of wind drifts and snow plowing, were about 1 foot high and 10 feet wide.

A Notice to Airmen (NOTAM) was issued by the FAA, at 0830, which described runway 15-33 as "patchy thin layer of loose snow, braking action - fair." At 0840, BGR issued a field condition report which stated, "RWY 15/33 - plowed 150 feet east of centerline and 75 feet west of centerline full length. Light dusting of snow. Braking fair. Snow removal in progress." According to the BGR Operations Manager, the 0840 field condition report was not relayed to the FAA Flight Service Station because the airfield maintenance supervisor was waiting to finish plowing the runway. Winds were reported to be from 050 degrees at 10 knots.

Prior to the arrival of the Safety Board, the first 8,000 feet of runway 33 was plowed to its full width of 300 feet, from the approach end toward the accident site. The airport management reported that they received approval to perform the plowing from an unidentified Federal Aviation Administration person after the accident.

The airport authority reported that measurements were taken before the snow plowing continued. The airplane's landing gear tracks indicated that the airplane touched down 7,200 feet from the approach end of runway 33. They also measured the right main landing gear touch down point to be about 35 feet to the left of the runway centerline.

The Safety Board measured the runway heading to be 339 degrees magnetic. Safety Board measurements also revealed that the runway was plowed approximately 55 feet to the west of

the runway centerline.

The main landing gear of the Beech 1900D, as published in the Pilot's Operating Manual, was 18 feet 4 inches wide from outside wheel edge to outside wheel edge. The airplane's left main landing gear exited the plowed portion of the runway at 7,802 feet, on a ground track of 329 degrees magnetic. The airplane's left main gear traveled approximately 90 feet left of the runway centerline, before returning to the plowed runway at 8,621 feet, on a ground track of 348 degrees magnetic. While traveling through the snow, the airplane's nose rotated to the right. The center of the airplane's fuselage came to a stop about 8,796 feet from the approach end of runway 33, on a magnetic heading of approximately 060 degrees.

Examination of the wreckage and runway, about 2200, the evening of January 10, 1997, revealed that the runway was covered with frozen precipitation. The runway was also observed to be sloped downward from the centerline, toward the outer edges of each side of the runway. When a Safety Board investigator placed a hard surfaced clip board on the left side of the runway centerline, the clip board slid to the snow bank, 55 feet left of the centerline.

## FLIGHT RECORDERS

### Cockpit Voice Recorder

The airplane was equipped with a Fairchild model A-100A cockpit voice recorder (CVR). The CVR was transported to the NTSB, Office of Research and Engineering, on January 10, 1997. The CVR committee convened on January 21, 1997, and a transcript was prepared of the entire 32:22 minute recording.

According to the CVR Group Chairman's report, examination of the CVR's four channels revealed that ATC and other radio transmissions, to and from the airplane, were recorded at very low levels and were, "difficult or impossible to hear except for the mike clicks at the beginning of each transmission."

### Flight Data Recorder

The airplane was equipped with a Fairchild model F1000 solid state flight data recorder (FDR). The FDR was transported to the NTSB Office of Research and Engineering on January 10, 1997, and a successful readout was completed. The NTSB Specialist's report contained takeoff data for the previous takeoff from Boston, and the accident flight. A review of the data revealed:

**Engine Power** - The data from the previous successful takeoff from Boston, depicted symmetrical acceleration of both engines to takeoff torque, over approximately 10 to 12 seconds. The accident takeoff data also depicted symmetrical acceleration of both engines to takeoff torque, in approximately 12 seconds.

**Propeller RPM** - The previous takeoff data revealed symmetrical acceleration of both propellers to approximately 1,700 RPM, in about 5 seconds. The accident flight data depicted symmetrical acceleration of both propellers to 1,678 RPM, in approximately 4 seconds

**Pitch Control Input** - The previous takeoff data revealed that pitch control traveled from minus 15 degrees, to a maximum positive control input of 7 degrees. This was reduced to 5 degrees over a 5 second period. The accident takeoff data depicted the pitch control traveled from minus 15 degrees, to a maximum positive control input of 6.3 degrees. This was reduced to 1.5 degrees, 1 second later. An additional second later, the pitch control input was increased to

3.24 degrees, followed by a reduction to 0.92 degrees after another second. During the pitch control inputs, the airplane's pitch attitude increased to a maximum of 7.7 degrees, and was reduced to between 4 and 5 degrees over the next 4 seconds, until power was reduced and the climb aborted.

**Airspeed** - During the Boston takeoff, the airplane's airspeed accelerated from zero to approximately 125 knots, in about 20 seconds. The accident takeoff data depicted an acceleration to 125 knots, in approximately 21 seconds. The accident airplane's airspeed was about 119 knots, at the maximum pitch up attitude of 7.7 degrees, and the indicated airspeed was 132.83 knots when the power was reduced, and the takeoff climb was aborted.

#### WRECKAGE INFORMATION

The wreckage was examined on the runway by the Safety Board, the evening of January 10, 1997. About 12 hours had elapsed from the time of the accident, until the Safety Board began their observations. During that time, a thin coating of snow had fallen on the airplane. After photographs and initial documentation were completed, the airplane was moved to a hangar.

Examination of the wreckage continued in a hangar at BGR, on January 11 and 12, 1997. The examination revealed that all components of the airplane were accounted for, except for the eight propeller blades, which were not attached to their respective hubs, and the nose wheel and strut.

The 4 left engine propeller blades were separated from their propeller hub, and located between 205 and 475 feet, left of the runway center line. The four blades were intact, not damaged on the leading edges, and did not have chord wise scratches.

The 4 right engine propeller blades were also separated from their propeller hub, and located between 91 and 175 feet left of the runway center line. One of the four blades displayed about 6 inches of broken material on the trailing edge of the blade, near the hub attachment point, and some scoring near the blade tip. The other three blades displayed impact damage along their trailing edges, and chord wise scratches on both sides of the blades. Each of the three blade tips were missing several inches. One of the three blades was broken chord wise in two pieces. White paint marks were observed on all four blades, similar to the white paint on the airplane's fuselage.

The airplane's fuselage contained a jagged opening between 4 and 10 inches wide. The opening extended from the water line (WL) 100.00, upward to the top of the fuselage cabin. The forward edge of the opening was abeam the rear of the first row passenger seat, 1F, and the rear edge was just forward of passenger seat 2F. The opening was about 18 inches aft of the right engine's propeller plane of rotation.

The airplane's main landing gear was extended and locked in position; however, the nose strut and wheel were separated from the fuselage and located in the snow bank on the left side of runway 33, about 240 feet beyond the entry point of the left main landing gear into the snow bank.

Examination of the airplane's engines and propellers did not reveal any preimpact failures. Visual inspection of both wing spars revealed no damage or distortion. The airplane was placed on jacks and all four main landing gear wheels rotated freely, the brakes did not drag, and brake wear was within tolerance.

The airplane's flight controls revealed that the electric and manual elevator trim systems

functioned. The elevator, rudder, and aileron controls were intact and remained operational. The cockpit rudder trim was set at .5 degrees nose left, the aileron trim was set to .5 degrees left wing up, and elevator trim was set to 3 degrees nose up.

#### MEDICAL AND PATHOLOGICAL INFORMATION

The toxicological testing report from the FAA toxicology Accident Research Laboratory, Oklahoma City, Oklahoma, was negative for drugs and alcohol for the captain and first officer.

#### TESTS AND RESEARCH

The Captain's and FO's altimeter and airspeed indicators were ground tested and determined to be within certificated limits.

The stall warning functional test in the cockpit was normal for horn and vane deflection in the ground position. When the airplane was jacked up to simulate flight, the stall warning horn sounded until the vane was pushed aft to simulate airspeed. Inspection of the stall warning vane drain assembly revealed that it was open and dry. The vane assembly was then removed from the leading edge of the left wing, and its cavity was inspected. The drain hole on the inboard lower side was unobstructed. A small amount of fluid accumulation was observed to be inboard of the drain hole. The fluid was a clear liquid without color, taste, or smell, consistent with water. When water was poured over the electrical connectors of the stall warning vane, and the tab was held aft with the airplane in the flight mode, the stall warning horn did not sound.

When the airplane was lowered to the ground, the ground mode stall warning heat was activated, and the stall warning vane warmed in less than 45 seconds. The airplane was jacked up again to simulate the flight mode, and the stall warning vane became too hot to touch in less than 60 seconds.

On March 14, 1997, ground checks and a test flight were performed on the airplane, following the completion of the airframe repairs. During the repairs, the stall warning system, which included the computer, were not disturbed. The checks and tests were performed by USAir maintenance personnel, and observed by an inspector from the FAA's Portland Flight Standard District Office.

According to the FAA Inspector's report, "NOTE: It was observed that there was a 3 - 4 kt. difference between the PIC and F/O airspeed indicators at 130 kts."

The Inspector's report also stated:

"It was determined that the target speeds...were all within limits...[the] stall horn was within limits on the PIC airspeed indicator, but one (1) kt. early on the F/O airspeed indicator. After landing, a discussion with the test pilot concluded that the aircraft should be left as is due to the indicator allowable tolerance..."

#### SERVICE DIFFICULTY REPORTS

##### Stall Warning System

The NTSB Investigator-In-Charge contacted the FAA Flight Standards Service, Safety Data Analysis Section, AFS-620, Oklahoma City, Oklahoma, and requested a print-out of all Service Difficulty Reports (SDR) concerning the stall warning system of the Beech 1900, for the period from 1990, to January, 1997. A total of 20 SDR's were provided by AFS-620. Ten of the



reports were a result of stall warning horn activation during the takeoff roll or inflight, and five of the activation's resulted in aborted takeoffs. Two of the five aborted takeoffs were reported to be due to "Maintenance found stall vane to be contaminated with ice." The corrective action by the maintenance personnel was, "Removed ice with stall heat vane system. Checked operation of heat system. System operationally checked satisfactory. Aircraft was returned to service."

A review of SDR and NASA reports of inadvertent (false) stall warning horn activation, revealed that a majority of the events occurred on a takeoff, immediately following airplane deicing.

#### Propeller System

The FAA Flight Standards Service, Safety Data Analysis Section, AFS-620, Oklahoma City, Oklahoma, also provided the Safety Board a print out of all Service Difficulty Reports (SDR) concerning the Hartzell Propellers installed on the Beech 1900, for the period from 1990, to January, 1997. Six reports of propeller blade separation were provided, of which none resulted in blade penetration of an airplane fuselage.

#### ADDITIONAL INFORMATION

##### MESA COMPANY HISTORY AND STRUCTURE

Mesa Airlines, Inc., headquartered in Farmington, New Mexico, began operation in 1980, as Mesa Air Shuttle. After several acquisitions, the company changed its name to Mesa Airlines, then Mesa Air Group, Inc. By September 1996, Mesa Air Group, Inc., controlled a number of subsidiaries, and on September 27, 1996, Mesa Air Group, Inc., changed its name to Mesa Airlines, Inc. (Mesa). According to their Operation Specifications (OpSpecs), valid at the time of the accident, Mesa was authorized to conduct operation under business names of America West Express, Desert Sun Airlines, Florida Gulf Airlines, Liberty Express Airlines, Mountain West Airlines, United Express, and USAir Express.

The OpSpecs listed the following airplanes that Mesa was approved to operate: 102 Beech 1900's, 14 Embraer 120RT's, 11 DeHavilland DHC-8's, and 2 Fokker F-70's. The Company held certificates to operate under 14 CFR Part 121 and Part 135. All Beech 1900 airplanes were operated under Part 135.

##### FAA OVERSIGHT

Oversight of Mesa Airlines, Inc., began with the FAA Flight Standards District Office (FSDO), in Albuquerque, New Mexico. The Mesa air carrier operating certificate was transferred to the Dallas/Fort Worth, Texas, FSDO (Certificate Holding District Office - CHDO), during September, 1996.

During December, 1995, a National Aviation Safety Inspection Program (NASIP) was conducted by the FAA, of Mesa Air Group, Inc. At that time, Mesa operated 100 Beech 1900's, 18 Embraer 120's, and conducted operation in all 9 of the FAA's Continental United States Regions. Mesa served 138 cities, 30 states, and over 2,200 daily departures. The company employed about 2,031 full-time and 342 part-time employees.

The Executive Summary of the report stated:

"Mesa Air Group was found to have deviated from its approved or accepted procedures in the areas of: Operations Training, Crew Qualification, Flight Operations, Maintenance Facilities

and Ramp Inspections. Potential problems with Mesa Air Group's system for assuring compliance with FAR requirements were identified in the procedures for: Operations Training, Crew Qualifications, Flight Operations, CASS, Maintenance Facilities, and Ramp Inspections."

The report further listed and described deficiencies in Mesa operations. Examples of these included:

Crew Qualification - Pilots who had failed their recurrent checkrides were given second checkrides without any record of re-qualification training, contrary to the Mesa aircraft training program. Mesa used five pilots as first officers that were also employed by their Pilot Development School as flight instructors; however, the commercial flight instructing hours were not tracked to ensure compliance with flight time limitations as required by FARs.

Operations Training - "The training programs for both aircraft omit the following subjects specifically required to be trained...avoidance of windshear, hail, and thunderstorms; ground training in practical meteorology, navigation and navigation systems, ATC procedures, systems, phraseology, normal and emergency communications, visual cues before and during descent below Decision Height (DH)/Minimum Decision Altitude (MDA), flight planning, and the Approved Flight Manual (AFM)..." The report also stated, "Neither the flight nor ground training curricula specifically referenced training in all the approach procedures authorized by the operator's Operations Specifications."

The report also stated that some flight maneuvers required for flight checks, were not described in the training program. The report also described deficiencies in the check airman training curriculum, and of three observed flight checks, all three resulted in failure of the candidate, "yet the check pilot appear to be making general use of waiver authority of certain required flight maneuvers...the company has no written policy or procedure for the use of waiver authority by check pilots..."

Flight Operations - The report discussed the BE-1900 crews were observed not checking oil quantity, oil caps and doors, or draining fuel sumps as required by the Pilot's Operating Handbook (POH). Additionally, required items in the POH were missing from the company BE-1900 Flight Manual and not covered in the Beechcraft Pilot's Checklist. Other items noted in the inspection report included manuals in the airplanes did not contain the current revisions, and there was no standardized method for accounting for carry on baggage weights.

During March, 1996, a Regional Aviation Safety Inspection Program (RASIP), was conducted by the FAA of Mesa Air Group, Inc. At that time, Mesa operated 111 Beech 1900's, 29 Embraer 120's, 7 DHC-8's, and 2 Fokker 70's, and conducted operation in all 9 of the FAA's Continental United States Regions. None of the FAA Inspector's that participated in the inspection were qualified on any of Mesa's types of airplanes. The report stated that due to that fact, the training programs were not evaluated for technical accuracy with regard to aircraft type.

The Overview of the report stated:

"The Mesa Airlines Approved Training Programs (curricula), consist of seven separate training programs, each containing its own basic indoctrination course of training. The programs do not share a common format. The programs are not constructed using the modular concept recommended by FAA Order 8400.10...With regard to FAR 135 flight training operations, Mesa makes general use of the provisions of FAR Section 135.341(c), and does not conduct recurrent flight training."

Additionally, Mesa's Recurrent Ground Training Curriculum did not appear to address several subjects required by FAR Section 135.345.

During June, 1996, a Special Emphasis Program (SEP) Report - Phase I, was conducted by the FAA of Mesa Air Group, Inc. At that time, Mesa operated 142 airplanes, and served 155 airports with an average of 2,000 daily departures.

The Executive Summary of the report stated:

"The object of this Special Emphasis Program is to determine if Mesa Air Group, Inc., is in compliance with the Federal Aviation Regulations, company policies and procedures that have FAA approved or acceptance, and FAA written guidance material."

The Executive Summary also stated that the SEP would be comprised of two phases. Phase I concentrated on en route, ramp, and spot inspections of Mesa's flight and maintenance operations. Phase II was to place special emphasis on Mesa's flight and maintenance operations, company manuals, policies, procedures, recording keeping, and general, safe operating practices. Phase I was completed on June 24, 1996. According to the SEP report:

"During Phase I, Mesa Air Group was found to be in non-compliance with various sections of Title 14 of the Code of Federal Regulations. Non-Compliance issues discovered in Phase I were discussed with company personnel and the CHDO. Those allegations that could not be satisfactorily resolved are listed in the body of this report. Where enforcement action is anticipated, those findings are currently under investigation by FAA personnel. "

"Mesa Air Group was non-compliant with Title 14 of the Code of Federal Regulations in the following areas:"

\* Lack of Operational Control \* Operation of Unairworthy Aircraft \* Improper Maintenance Procedures \* Failure to Comply with Approved Manuals

"Mesa Air Group appears to have significant problems that would affect continued compliance with Title 14 of the Code of Federal Regulations in the following areas:"

\* Corporate Organization Structure \* Quality Assurance/Quality Control \* Training \* Staffing - Adequate Level and Experience \* Manuals/Publications - Control and Distribution

Special Emphasis Program Report - Phase Two (SEP II), July, 1997

The background section of the SEP II report stated:

"Due to concerns resulting from previous Federal Aviation Administration (FAA) routine and regional/national (RASIP/NASIP) inspections, in June 1996, the FAA Southwest Region initiated Phase I of a Special Emphasis Program (SEP I) for MASA. SEP I was intended to provide a regulatory compliance 'snap shot' of operations and maintenance of MASA aircraft at that time. Findings identified during SEP I resulted in the legal Consent Order agreed upon and signed by MASA and the FAA on September 25, 1996. The particulars of SEP I and the resulting Consent Order fall outside of the purview of this report. It should be noted, however, that many of the program enhancements resulting from MASA's compliance with this Consent Order have direct bearing on correction of SEP II findings."

The SEP II report covered a period from November 1996, through July 1997, and highlighted corrective actions taken after January 10, 1997. Therefore, SEP II is not addressed in this report.

A Consent Order, signed by the FAA and Mesa Airline, Inc., on September 25, 1996, provided specific periods of time in which corrective action was required to be taken. Areas of interest that the Safety Board was investigating as a result of the accident, were identified in Attachment B of the Consent Order. These areas were listed as "Within 120 days after the consent order is signed..." Therefore, corrective action was not required to be completed until January 25, 1997.

## COMPANY TRAINING

### Training Manual

A review of the Mesa Airlines, Inc., BE-1900 Pilot Training Manual 710, Revision, dated September 20, 1995, revealed the following:

1. The Training Manual did not follow FAA Guidelines set forth in FAA 8400.10, Vol III, Chapter 2, titled: Training Programs and Airmen Qualifications.
2. Training modules did not describe specific lesson plans or time allocation for specific courses subjects.
3. Reference materials and training aids used in training curricula were not included in the training manual.
4. Specific Curricula or Training Modules for winter operations, including: airplane surface contamination, airplane performance and flight characteristics with surface contamination, cold weather preflight inspection procedures and techniques for recognizing contamination on the airplane were not specifically mentioned in the training manual.

### Ground and Flight training Records

A review of the Mesa Airlines, Inc., Pilot Ground and Flight Training Records revealed that specific information regarding training of course segments or modules was not included on the Pilot Ground Training Record. The only information regarding pilot training received, was a curriculum completion date and supervisor's signature. The date or allocated time a pilot received training in a specific segment or module was not available.

Mesa presented a new modular training program to the FAA CHDO for review and approval on December 4, 1996. The manual, which was required by the Consent Order, was approved by the FAA on December 22, 1996.

### Stall Recognition and Stall Recovery Training

Stall recognition and recovery training parameters were described in the Mesa Airlines Inc., BE-1900 Pilot Training Manual. The Training and Flight Standards Section of the Company Flight Manual described stall recognition and recovery procedures for the BE-1900D.

The stall recognition and recovery procedures stated that the pilot should hold altitude on entry and recovery. It also stated that stall recovery would be initiated at the first indication of a stall (buffet or stall warning horn). Interviews with the flight crew and company check pilots revealed that during training flights, stall recovery was initiated at the sound of the stall horn.

The FAA Commercial Pilot, Practical Test Standards, FAA-S-8081-12A, listed the standards that a pilot applicant must complete during a flight test. Under the Tasks for Power-On and Power-Off Stalls, the same procedure was listed, which stated, "Recognizes and announces the onset of the stall by identifying the first aerodynamic buffeting or decay of control

effectiveness."

The FAA Airline Transport Pilot and/or Type Rating, Practical Test Standards, FAA-S-8081-5B, also listed the standards that a pilot applicant must complete during a flight test. Under the Task for Approaches To Stalls, it stated that an applicant must perform three approaches to a stall. They include takeoff, clean, and landing configuration stalls. The recover procedure listed for the stalls stated, "Announces the first indication of an impending stall (such as buffeting, stick shaker, decay of control effectiveness, and any other cues related to the specific airplane design characteristics) and initiates recovery..."

Also, Beech 1900 simulators were not used during any phase of flight crew training.

## DEICING PROCEDURES

According to the captain and the deicing crewmembers, the deicing began with the left wing, then proceeded counter-clockwise to the tail, right wing, then to the nose of the fuselage.

According to the Mesa operations specifications, A23c-2, "The left wing will be deiced first with the deicing accomplished in a clockwise fashion. This will ensure the aircraft tail is deiced last."

## COLD WEATHER OPERATIONS

### BE-1900 Checklist

The BE-1900 Checklist called for certain airplane systems and components to be activated for taxi and flight in icing conditions. The extension of the ice vanes was listed on the After Start Checklist. Other cold weather operations components were listed on the Takeoff Final Items Checklist which was called for by the Captain when the airplane was cleared to taxi onto the runway for takeoff. This was the final checklist before takeoff, and included the fuel vent heat, pitot heat, alternate static heat, and the stall warning heat.

### Pilot's Operating Manual (POH)

The POH contained a statement in the Safety Information section, which stated:

"Ice build-up, and its extent in unprotected areas may not be directly observable from the cockpit. Due to distortion of the wing airfoil, increased drag and reduced lift, stalling speeds will increase as ice accumulates on the airplane. For the same reasons, stall warning devices are not accurate and cannot be relied upon in icing conditions."

The Beech 1900 POH contained several sections in the Normal Procedures Chapter that took the pilot from Preflight to Shutdown. In the Preflight Section of the left wing, item number six stated, "Stall Warning Vane - Check." However, at the beginning of the Preflight Section, a note stated that after the first flight of each day, the Preflight Inspection may be omitted except for items marked with a "+." The stall warning vane was not marked with a "+." Therefore, checking the stall vane was not mandatory during subsequent preflights, even though the pilot would pass directly in front of the stall vane, while checking the fuel caps and landing gear on subsequent preflights.

The POH also listed, "Ice Protection - AS REQUIRED," under the Before Takeoff (Final Items) section of the Normal Procedures. One of the items listed under that topic was the stall heat switch. When the stall heat switch was selected on, the stall warning heat element was then controlled through a relay, and the landing gear safety switch. When the airplane was on

the ground, the voltage was reduced to the stall warning heating element, and provided low heat. When the airplane departed the ground, the landing gear safety switch activated an increase in voltage to the stall warning element, and increased the element temperature.

The items in the Before Takeoff section were normally accomplished after the flightcrew was cleared for takeoff. The CVR transcript revealed that during the accident flight, ice protection items were addressed about 37 seconds before power was applied for takeoff, 58 seconds before the call of "V one rotate," and 60 seconds before the sound of the stall horn was heard.

#### Airplane Flight Manual

The Beechcraft BE-1900 Airplane Flight Manual (AFM), contained a Warning in Section IV, Normal Icing Operations, and stated in part:

"Due to distortion of the wing airfoil, stall warning devices are not accurate and should not be relied upon. With ice accumulations on the airplane, a significant aerodynamic buffet will occur in advance of the stall with the flaps up. With flaps down, buffet may not occur until very close to the stall..."

The AFM also contained the following notes:

"Landing gear position has no effect on stall speed. For operation with normal ice accumulation, all stall speeds may increase 10 knots."

#### AIRSPEED INDICATOR READINGS

The three arrows called "speed bugs," on both pilots airspeed indicators, were made of plastic and movable with light finger pressure. Photographs of the airspeed indicators were taken by BGR airport personnel following the accident, before the arrival of the NTSB. The approximate settings in the photographs were as follows:

Pilot, left side: 114, 122, and 130. Pilot, right side: 108, 118, and 122.

The following was obtained from the CVR transcript and performance card:

CVR Briefed Speeds: 108, 118, and 122. Performance Card: 108, 118, and 122.

Cockpit readings were recorded after the airplane was moved to the hangar for examination, and those readings differed from the photo.

According to the performance card, 108 represented V<sub>1</sub>/ V<sub>r</sub>, 118 represented V<sub>2</sub>, and 122 represented V<sub>ner</sub>. The Mesa Company Flight Manual defined V<sub>1</sub> speed in part as: Takeoff Decision Speed. The speed at which the decision to continue the takeoff results in a takeoff distance to a height of 35 feet at V<sub>2</sub> speed, that will not exceed the useable takeoff distance; or the distance to bring the airplane to a full stop will not exceed the accelerate stop distance available. V<sub>r</sub> was published as rotation speed, and the Mesa Company Flight Manual defined V<sub>2</sub> as the takeoff safety speed at 35 feet above ground level assuming engine failure recognized at V<sub>1</sub>.

According to the FDR data, the airplane's airspeed was about 119 knots, at the maximum pitch up attitude of 7.7 degrees, and the indicated airspeed was 132.83 knots, when the power was reduced, and the takeoff climb was aborted.

According to a Beech 1900 stall speed chart, the estimated stall speed for the weight and

environment condition of the accident airplane was 97.5 KIAS.

The wreckage was released on January 14, 1997, to Rick Davis, a representative of USAir Express.

### Pilot Information

<b>Certificate:</b>	Airline Transport; Commercial	<b>Age:</b>	32, Male
<b>Airplane Rating(s):</b>	Multi-engine Land; Single-engine Land	<b>Seat Occupied:</b>	Left
<b>Other Aircraft Rating(s):</b>	None	<b>Restraint Used:</b>	Seatbelt, Shoulder harness
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>	None	<b>Toxicology Performed:</b>	Yes
<b>Medical Certification:</b>	Class 1 Valid Medical--no waivers/lim.	<b>Last FAA Medical Exam:</b>	12/06/1996
<b>Occupational Pilot:</b>	<b>Last Flight Review or Equivalent:</b>		
<b>Flight Time:</b>	5800 hours (Total, all aircraft), 350 hours (Total, this make and model), 3800 hours (Pilot In Command, all aircraft), 207 hours (Last 90 days, all aircraft)		

### Aircraft and Owner/Operator Information

<b>Aircraft Make:</b>	Beech	<b>Registration:</b>	N139ZV
<b>Model/Series:</b>	1900D 1900D	<b>Aircraft Category:</b>	Airplane
<b>Year of Manufacture:</b>		<b>Amateur Built:</b>	No
<b>Airworthiness Certificate:</b>	Normal	<b>Serial Number:</b>	UE-139
<b>Landing Gear Type:</b>	Retractable - Tricycle	<b>Seats:</b>	19
<b>Date/Type of Last Inspection:</b>	Continuous Airworthiness	<b>Certified Max Gross Wt.:</b>	16950 lbs
<b>Time Since Last Inspection:</b>	40 Hours	<b>Engines:</b>	2 Turbo Prop
<b>Airframe Total Time:</b>	3565 Hours	<b>Engine Manufacturer:</b>	P&W
<b>ELT:</b>	Installed, not activated	<b>Engine Model/Series:</b>	PT6A-67D
<b>Registered Owner:</b>	MESA AIR GROUP, INC.	<b>Rated Power:</b>	1279 hp
<b>Operator:</b>	MESA AIRLINES INC.	<b>Operating Certificate(s) Held:</b>	Commuter Air Carrier (135)
<b>Operator Does Business As:</b>	USAIR EXPRESS	<b>Operator Designator Code:</b>	MASA

## Meteorological Information and Flight Plan

Conditions at Accident Site:	Instrument Conditions	Condition of Light:	Day
Observation Facility, Elevation:	BGR, 192 ft msl	Distance from Accident Site:	0 Nautical Miles
Observation Time:	0930 EDT	Direction from Accident Site:	0°
Lowest Cloud Condition:	Unknown / 0 ft agl	Visibility	1 Miles
Lowest Ceiling:	Obscured / 300 ft agl	Visibility (RVR):	0 ft
Wind Speed/Gusts:	10 knots /	Turbulence Type Forecast/Actual:	/
Wind Direction:	50°	Turbulence Severity Forecast/Actual:	/
Altimeter Setting:	29 inches Hg	Temperature/Dew Point:	20° C / 20° C
Precipitation and Obscuration:			
Departure Point:	(BGR)	Type of Flight Plan Filed:	IFR
Destination:	BOSTON, MA (BOS)	Type of Clearance:	IFR
Departure Time:	0000	Type of Airspace:	Class D

## Airport Information

Airport:	BANGOR INTL (BGR)	Runway Surface Type:	Concrete
Airport Elevation:	192 ft	Runway Surface Condition:	Ice; Snow--compacted; Snow--dry
Runway Used:	33	IFR Approach:	
Runway Length/Width:	11439 ft / 300 ft	VFR Approach/Landing:	

## Wreckage and Impact Information

Crew Injuries:	2 None	Aircraft Damage:	Substantial
Passenger Injuries:	2 Minor, 7 None	Aircraft Fire:	None
Ground Injuries:	N/A	Aircraft Explosion:	None
Total Injuries:	2 Minor, 9 None	Latitude, Longitude:	



## Administrative Information

<b>Investigator In Charge (IIC):</b>	ROBERT L PEARCE	<b>Report Date:</b>	04/30/1998
<b>Additional Participating Persons:</b>	LARRY SMITH; WASHINGTON, DC JENS MALMBORG; JACKSONVILLE, FL RANDY COUNTISS; HERNDON, VA PAUL F CROSBY; SALISBURY, MD		
<b>Publish Date:</b>			
<b>Investigation Docket:</b>	NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at <a href="mailto:pubinq@ntsb.gov">pubinq@ntsb.gov</a> , or at 800-877-6799. Dockets released after this date are available at <a href="http://dms.nts.gov/pubdms/">http://dms.nts.gov/pubdms/</a> .		

The National Transportation Safety Board (NTSB), established in 1967, is an independent federal agency mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The NTSB makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report. A factual report that may be admissible under 49 U.S.C. § 1154(b) is available [here](#).